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Technical Report

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A Compilation Catalog in the Direction of the Galactic Center

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S.A. Stansfield

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Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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A COMPILATION CATALOG IN THE DIRECTION OF THE GALACTIC CENTER

L.G. TAFF S.A. STANSFIELD Group 94

TECHNICAL REPORT 635

18 JANUARY 1983

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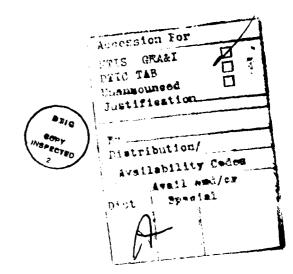
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ABSTRACT

This paper describes the construction of a catalog of positions and proper motions for 130 stars in the direction of the galactic center.

All available information for stars within ~2° of this point has been utilized to produce the best and densest possible reference system. The reference frame of the catalog is that of the Southern Reference Star (SRS) program. The typical star in this catalog has a position and angular velocity based on 16 observations from six source catalogs whose epochs of observation span 77 years. The root mean square positional uncertainty is 0.49 at 1975.0. A total of 13 source catalogs dating back to 1847 have been used. Additional information includes central dates for right ascension and declination, position and proper motion variances, identification numbers, and apparent magnitudes.



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I. INTRODUCTION

Astronomers and astrophysicists who work in wavelength bands outside of the visual region of the electromagnetic spectrum rely on the results of optical astronomers for networks of reference stars from which accurate positions of their sources of radiation may be derived. Frequently the optical counterparts of non-optically detected sources are very faint or lie in the southern half of the celestial sphere. Both of these situations arise in galactic center work. According to Oort (1977) the direction of the galactic center is $\alpha_{\rm GC}$ =17^h42^m29^s3, $\delta_{\rm GC}$ =-28°59'18" (1950.0). Infrared mapping of the galactic center region reveals 10 distinct sources within 10" of $(\alpha_{GC}, \delta_{GC})$ (Becklin and Neugebauer 1975). Radio interferometry of this same area of the sky discloses a large number of thermal sources (Brown, Johnston, and Lo 1981) including the most powerful non-thermal source in the Galaxy (Kellermann et. al. 1977). This source congestion hinders the identification of the infrared sources with the radio ones. This problem is exacerbated by the lack of astrometric work near the galactic center. For reference stars in this direction most workers probably turn to the Smithsonian Astrophysical Observatory Star Catalogue (SAOC; Staff of the SAO 1966). A typical SAOC star (... this part of the sky has a position based on two observations (both epoch ~ 1933) and a proper motion based on four observations (the preceding two observations and two more at epoch ~ 1896). This star's positional uncertainty is 0.97 at 1975.0 and 1.50 at 2000.0. In this paper we do better than the SAOC and at a star density half of its ~ 15 stars per square degree. For the 130 stars in this catalog a typical position and angular velocity depend on 16 observations extending over 77 years. The average positional uncertainty at 1975.0 is 0.49, at 2000.0 it's 0.72. Equally important is the fact that this compilation catalog is on the

reference system of the Southern Reference Star (SRS) program.

The catalog itself is in Table III and is available in punched card form from the authors. The next section discusses the details of its formation. The epoch of orientation and epoch of place for Table III is 1950.0.

II. CATALOG FORMATION

a) Area of the Sky

Catalogs observed at the Cordoba Observatory are important for this work. Cordoba's latitude is -31°25'. Rather than correct for possible zenith discontinuities using a small sample, we chose to stay north of this declination. North of Cordoba's zenith both the Cordoba extension of the AGK1 and the Yale photographic zone catalogs are discontinuous at δ =-27°. Hence we accepted -27° as a northern limit and, since δ_{GC} ~-29°, we have used the range $\delta \epsilon$ [-27°,-31°]. Our right ascension limits are $\alpha \epsilon$ [17^h33^m30^s, 17^h51^m30^s]. The area is 15.74 square degrees. A few SRS stars within 0°5 of these boundaries have been included to strengthen the link to the SRS system.

b) Source Catalogs

A total of thirteen catalogs have been used. In addition three catalogs were used to form our local approximation to the SRS system (see below). The source catalogs are

- Catalogue of 23521 Stars between 13°35' and 45°25'
 South Declination (WaZ; Eichelberger and Littell 1911)
- Katalog der Argelander'schen Zoner von 15. bis 31. Grade
 Sudlicher Declination (AW; Weiss and Argelander 1890)
- 3) Catalogo de Zonas Estrellas (GA; Gould 1884a, b)
- 4) Catalogue of 12441 Stars for the Epoch 1880 (Cp 80; Stone 1881)

- 5) Catalogo General Argentino (Gou; Gould 1886)
- 6) Catalogo de 15200 Estrellas (Cord B; Perrine 1914)
- 7) Albany Zone Catalogue of 8276 Stars Between -20° and -41° for the Epoch 1900 (Alboo; Boss 1918)
- San Luis Catalogue of 15333 Stars for the Epcoh 1910
 (SL; Tucker, Roy, and Varnum 1928)
- 9) Catalogo Astrografico (AC: Perrine 1927a, b, 1928, 1931, 1932, 1933)
- 10) Catalogo de 6429 Estrellas de Repere (G; Guerin 1934)
- 11) Cape Photographic Catalogue for 1950.0 (CPC; Jackson and Stoy 1954)
- 12) Catalogue of the Positions and Proper Motions of 9455 Stars (YT13, II; Schlesinger and Barney 1943)
- 13) Catalogue of the Positions and Proper Motions of Stars

 Between Declinations -30° and -35° (YT28; Hoffleit 1967).

In Table I we have listed, for each catalog, the standard deviation of $\Delta\alpha\cos\delta$ and $\Delta\delta$ based on two observations, the mean epoch of the observations for the stars included here, the mean number of observations for the stars included here, the number of stars in the source catalog included here, and the systematic difference between the catalog and our local approximation to the SRS system ($\Delta\alpha\cos\delta$ and $\Delta\delta$ in the sense source catalog - SRS). The standard deviations of the positions are the more conservative of the values found in the individual catalog's introductions and the values summarized by Eichhorn (1974). Star identifications for the oldest catalogs comes from the Geschichte des Fixsternhimmels.

TABLE I
SUMMARY OF SOURCE CATALOGS

Catalog	^σ Δα cosδ	$\sigma_{\Delta \delta}$	Mean	Average	Number	Systematic	Differences ^a
	(2 observ	rations)	Epoch	No. Obs.	of Stars	Δα cos δ	Δδ
WaZ	1.5	1:4	1847.1	2.4	92	-0"24	133
AW	1.7	1.1	1849.9	1.3	55	-0.16	3.10
GZ	0.73	0.71	1873.6	1.4	99	0.41	1.62
C p8 0	0.89	0.58	1878.3	4.3	14	-0.12	0.89
Gou	0.81	0.70	1878.7	3.4	31	1.17	0.34
Cord B	0.54	0.54	1896.3	2.0	130	-0.04	0.14
A16 ₀₀	0.39	0.58	1897.2	2.3	31	0.84	0.15
SL	0.36	0.36	1910.0	5.4	14	-0.03	-0.45
AC	0.56	0.48	1913.6	2.0	130	-0.05	-0.41
G	0.24	0.27	1917.6	2.0	32	-0.30	-0.40
CPC	0.22	0.22	1931.6	2.0	53	-1.19	0.42
YT <u>13</u> , II	0.16	0.16	1933.6	2.0	96	-0.77	0.48
/T <u>28</u>	0.35	0.35	1956.3	2.0	53	0.31	0.65

^aIn the sense source catalog - SRS.

c) Star Selection

Consistent with our small sample and area, and our aim of producing the highest quality compilation catalog possible, we chose for inclusion all SRS stars near (α_{GC} , δ_{GC}) (20 in toto) plus 110 additional stars within the above mentioned right ascension and declination ranges with good observational histories. These can be divided into four groups: (i) in WaZ or AW as well as YT28, Δ t~ 108 yrs; (ii) in WaZ or AW and YT13, II, Δ t~ 85 yrs; (iii) in one of Gou, GZ, or Cp80 (but not earlier) and YT28, Δ t~ 60 yrs. Of the stars we've included 23% are in the first group, 58% are in the second group, and 19% are in the last two groups. Stars in the last group have the fewest observations (9 on the average) but appear in both YT28 and the CPC.

After inspecting the older catalogs it became clear that an individual observation could not confidently carry much weight. Hence no single observation from the oldest five catalogs is included unless there is an observation from one of the other catalogs at a comparable epoch.

d) The SRS System

We have written of "our local approximation to the SRS system" because the formation of the SRS is not yet complete. However, we had available observations from three major sources of the SRS--1) the Perth 70 catalog (Hog et. al. 1976), 2) the Santiago 67 Catalog (Carrasco and Loyola, 1982), and 3) unpublished observations of the U.S. Naval Observatory (Smith 1982). We constructed a weighted mean of these three catalogs for the 20 SRS stars in the vicinity of $(\alpha_{GC}, \delta_{GC})$. See Table II. The departures of

TABLE II

POSITIONS FOR SRS STARS

I.D. Nu Cordoba	mber SRS	Number of Obs.	α ^{&}	^σ α cos δ	Epoch ^b for a	δ ^a	σ_{δ}	Epoch ^b for 6
11129	14284	13	17 ^h 31 ^m 29 ^{\$} 046	0:022	1969.73	-29°13'23"31	0:103	1969.00
11136	14292	11	17 32 01.062	0.060	1969.02	-28 10 17.61	0.042	1967.36
11148	14303	11	17.32 59.918	0.059	1968.53	-30 30 39.30	0.068	`967. 37
11193	14352	12	17 37 31.658	0.049	1968.30	-30 25 03.54	0.079	969.40
11195	14355	14	17 37 34.023	0.053	1970.61	-27 52 03.32	0.064	∍ 69.34
11197	14356	10	17 37 41.300	0.079	1968.60	-29 34 28.27	0.086	18
11210	14369	13	17 38 43.185	0.045	1968.48	-31 19 35.95	0.046	.07.63
11229	14378	10	17 40 12.700	0.076	1967.94	-27 13 10.96	0.097	1969.3
11251	14398	13	17 41 54.397	0.035	1970.21	-30 09 47.44	0.054	1970.04
11273	14406	14	17 42 49.344	0.038	1969.52	-28 39 33.14	0.058	1969.5
11278	14412	11	17 43 25.618	0.044	1969.24	-29 38 51.55	0.062	1967.30
11291	14424	10	17 44 22.195	0.054	1968.59	-31 10 21.86	0.076	1967.63
11316	14436	11	17 45 41.339	0.033	1969.89	-28 13 50.02	0.064	1968.29
11315	14437	9	17 45 42.429	0.070	1968.89	-30 28 45.39	0.039	1968.3
11364	14466	15	17 48 21.185	0.054	1969.33	-31 24 03.09	0.046	1967.0
11389	14475	13	17 49 15.350	0.061	1969.06	-29 32 32.96	0.087	1968.4
11400	14484	13	17 50 11.786	0.035	1968.42	-28 02 49.69	0.087	1968.7
11425	14504	12	17 52 02.631	0.037	1966.86	-30 35 35.98	0.097	1967.5
11438	14509	12	17 52 24.634	0.024	1969.02	-29 58 12.96	0.064	1967.9
11451	14514	12	17 53 04.666	0.012	1970.11	-31 10 57.32	0.088	1969.6

 $^{^{\}mathbf{a}}$ Epoch of orientation 1950.0

bThese are epochs of place.

the final SRS system from this one should be at a level well below our average positional uncertainty at 1975.0 (σ =0.49).

e) Systematic Differences

Before computing a position and proper motions for a star all of its positions must be in the same coordinate system. We have insured this by handling general precession on a star by star basis. The precession employed by the catalog's generators from the epoch of place of a star to the catalog's epoch of orientation has been removed. Rigorous general precession was applied to 1950.0 following the procedures summarized in Eichhorn (1974). The computation of the systematic differences between the source catalogs and our local approximation to the SRS system proceeded in a stepwise fashion using the Cordoba B as an intermediary. (The Cordoba B catalog contains all of our stars and its epoch is roughly midway between the extremes of the other source catalogs.) The systematic differences between the individual source catalogs and the SRS are in the rightmost columns of Table I.

f) Data Reduction

Each star's right ascensions and declinations were then separately fit by the method of least squares, with appropriate weights, to the following equations:

$$\alpha(t) = \alpha(0) + \mu_{\alpha}(0)t$$

$$\delta(t) = \delta(0) + \mu_{\delta}(0)t$$

From the matrix of the normal equations we calculated the central date, t_{C} for right ascension and declination and from the inverse of this matrix we found $\sigma_{\alpha cos \delta},$ etc. in the usual fashion. Note that the covariance of $\alpha(0)$ and $\mu_{\alpha}(0)$ vanishes at t_{C} (and similarly for the declination and its associated central date).

III. THE CATALOG

Listed in Table III, for epoch of orientation 1950.0 and epoch of place 1950.0, are $\alpha, \delta, \mu_{\alpha}$, and μ_{δ} for every star. Also listed are the central dates and the standard deviations of $\alpha, \delta, \mu_{\alpha}$, and μ_{δ} at the central dates. Estimates for $\sigma_{\alpha}(t)$ and $\sigma_{\delta}(t)$ can be computed from

$$\sigma^2_{\alpha,\delta}$$
 (t) = $\sigma^2_{\alpha,\delta}$ (t_c) + $\sigma^2_{\mu_{\alpha},\mu_{\delta}}$ (t_c)(t-t_c)²

See also Eichhorn and Googe (1969).

From the data in Table III we have computed the average values of the root mean square positional error at 1950.0, 1975.0, and 2000.0. They are

$$\langle \sigma(1950.0) \rangle = 0.28$$

 $\langle \sigma(1975.0) \rangle = 0.49$
 $\langle \sigma(2000.0) \rangle = 0.72$

Finally, Figure 1 is a finding chart of the area. It is based on a blow up of the appropriate SAOC chart.

TABLE III

CATALOG OF POSITIONS AND PROPER MOTIONS

### 1 3 1/cmf 5 1/cmf 6 1/cmf	(I) Cordoba	(2)		(3) R.A. ^b		€ ⁴ 2 ⁵	(S)	(6) 2 ² 2	(7) Central	(8) Dec. ^b	۵	(6) a n	(10) %	(E) %3	(12) Centrel
0.5 17 32 29,441 0,026 0,0236 1965,67 -29 13 23,43 0,74 0,064 0,417 0.8 17 32 29,441 0,026 0,0236 1963,62 -20 10 17,28 -1,59 0,064 0,325 0.8 17 32 59,749 -6,116 0,025 0,4273 1964,44 -50 39,36 0,36 0,32 0,346 0.9 17 32 59,749 -6,116 0,0218 0,441 1925,77 -27 4 0,00 0,50 0,141 0,173 0.9 17 39 21,232 -0,120 0,012 0,0318 0,441 1925,77 -27 4 0,00 0,50 0,141 0,173 0.9 17 39 21,232 -0,120 0,012 0,0318 0,047 1926,43 -20 12 20,23 1,10 0,115 0,047 0.9 17 39 21,232 -0,120 0,012 0,031 1929,05 -30 0,56 -3,70 0,115 0,047 0.9 17 39 21,232 -0,289 0,012 0,031 1929,05 -30 22 50,01 -1,66 0,116 0,641 0.9 17 39 21,232 -0,289 0,012 0,031 1929,05 -30 0,56 -3,70 0,112 0,132 0,647 0.9 17 39 21,232 -0,289 0,012 0,031 1929,05 -30 0,57 0 0,112 0,112 0,570 0.9 17 39 21,232 0,289 0,011 0,0039 0,046 1927,96 -30 0,57 0 0,12 0,112 0,503 0.1 17 39 21,232 0,131 0,0039 0,046 1927,96 -30 0,72 0,13 0,110 0,583 0.1 17 36 2,432 0,131 0,0039 0,046 1927,97 -27 4 92,3 -2,01 0,110 0,583 0.1 17 36 2,432 0,131 0,0039 0,046 1927,97 -27 4 92,3 -2,01 0,110 0,583 0.1 17 36 2,433 0,131 0,0039 0,046 1927,97 -27 4 92,3 -2,01 0,110 0,583 0.1 17 36 2,432 0,003 0,011 0,0039 0,047 1922,37 -27 4 92,3 -2,01 0,10 0,10 0,04 0.9 17 36 2,422 0,009 0,011 0,0099 0,005	2	9	_	 E	•	/cent	•	s/cent	Date e	•	•	"/cent	•	"/cent	Pa te
0.5 17 25 10 17.25 -1.07 -0.0946 0.0036 1963.6 -0.034 1963.6 -0.034 -0.034 -0.034 -0.034 -0.034 -0.034 -0.034 -0.034 -0.034 -0.034 -0.034 -0.034 -0.044 <th< td=""><td>11129</td><td>:</td><td>•</td><td></td><td></td><td>.02%</td><td>0.0036</td><td>0.0244</td><td>1964.67</td><td>-29 13</td><td>23.43</td><td>17:0</td><td>0.064</td><td>0.417</td><td>1900.28</td></th<>	11129	:	•			.02%	0.0036	0.0244	1964.67	-29 13	23.43	17:0	0.064	0.417	1900.28
6.5 17 35 59,940 -6,116 0,0036 0,0273 1964,84 -50 30 39,36 0,056 0,134 1,713 0.5 17 35 50,579 0,116 0,401 1925,77 -27 4 0.00 0,50 0,131 1,713 0.5 17 34 4,922 -0,182 0,812 1925,79 -31 11 24,62 2.21 0,150 0,190 0.7 17 34 2,132 -0,180 0,812 1932,96 -30 12 50,31 0,112 0,	11156	. 6.2	11				9500.0	0.0280	1963,62	-20 10	17.20	-1.55	.064	0.325	1959.35
4.5 17 55 57 6.18 6.0110 6.0461 1955.77 -27 4 6.05 6.18 6.1	11140	:	11		-	116	9.0036	0.0273	1964.44	-30 50	39.36	0.32	0.065	0.346	1700.60
9.2 17 34 4.992 -0.104 0.0126 1932.95 -11 2.66 2.21 0.115 0.105 0.9074 1932.95 -10 0.556 -3.70 0.115 0.906 0.9 17 34 21.32 -0.106 0.0164 1932.96 -20 0.517 0.0172 0.0112 0.112 0.112 0.112 0.112 0.112 0.012 <td>111157</td> <td>•</td> <td>=</td> <td></td> <td></td> <td>.102</td> <td>0.110.0</td> <td>0.4601</td> <td>1925.77</td> <td></td> <td>9.00</td> <td>0.50</td> <td>4.141</td> <td>4.713</td> <td>1524.54</td>	111157	•	=			.102	0.110.0	0.4601	1925.77		9.00	0.50	4.141	4.713	1524.54
9.2 17 36 20.132 -0.100 0.0110 0.0649 1922.96 -50 12 50.33 3.57 0.1115 0.9616 9.1 17 36 21.262 -0.075 0.0549 1926.93 -20 12 50.33 3.57 0.112 0.962 0.1 17 36 21.262 -0.076 0.033 1929.03 -20 52 50.01 -1.66 0.112 0.164 0.0 17 36 21.262 0.086 0.087 0.035 1926.36 -20 52 50.01 -1.66 0.112 0.164 0.0 17 36 21.766 0.086 0.086 0.086 1926.36 -20 60 -20 60 0.087 0.086	95117	9.3			•	.161	0.0120	0.0767	1932,45	-31 11	24.62	2.21	0.165	1,947	1951.66
6.9 17 34 21.542 -6.99 0.0110 0.0649 1926.43 -26 12 5.57 0.112 0.0451 6.1 17 34 37.385 -6.99 0.0129 0.0531 1929.05 -26 24 1.66 0.116 0.116 0.116 0.045 6.0 17 34 44.076 -6.042 0.0476 1975.26 -26 24 1.66 0.116 0.0476 1975.26 -26 24 1.66 0.116 0.0476 1976.36 -26 24 26.01 -1.66 0.116 0.0476 1976.36 -26 27.34 1.66 0.116 0.0476 1976.36 -26 27.34 0.017 0.117 0.0476 0.0476 1976.36 -26 27.34 0.017 0.0476 0.0476 1976.36 -26 27.34 0.017 0.0476 1976.36 -26 27.34 0.017 0.0476 1972.36 -26 27.34 0.017 0.0476 1972.37	11160	9.2	7.	1.55 #	-	•		0.0740	1932,96		35,66	-3.70	0.115	0.961	1952,67
6.1 17 34 31.385 -6.699 -6.031 1929.05 -30 32 50.01 -1.66 0.116 0.146 0.146 6.0 17 34 34.096 0.082 0.0976 1970.2 -26 27 29.42 1.66 0.1112 0.570 6.9 17 34 24.046 0.082 0.0877 1926.34 -26 7 24.34 0.097 0.047 1926.34 -26 7 24.34 0.097 0.043 1926.34 -26 7 24.34 0.099 0.045 1926.34 -27 4 54.34 0.099 0.044 1926.34 -27 4 56.62 2.32 0.142 0.053 7.1 17 34 22.47 0.084 0.044 1976.46 -27 4 56.62 2.32 0.142 0.042 8.7 17 35 21.24 0.084 0.084 1971.53 -28 2.35 0.124 0.124 0.156 8.6 17 36 21.24 0.084 0.084 1972.35 -28 2.35 1.26 0.123 0.123 8.6 17 36 21.24 0.084 0.084 1972.35 -28 2.35 0.123 0.1	11111	•	-	34 21.5			0.0110	0.0649	1926.43	-28 12	56,33	3,57	0.142	0.425	1925.91
6.6 17 34 34.0% 6.002 0.0045 0.0045 1919.02 -26 24 29.42 1.66 0.112 0.570 6.9 17 34 44.076 -0.026 0.0110 0.0659 1926.36 -30 0.766 -0.11 0.142 0.637 9.5 17 34 44.076 0.021 0.0110 0.0652 1926.34 -20 7 24.34 -0.09 0.112 0.0653 1926.34 -20 7 24.34 -0.09 0.112 0.0653 1926.34 -20 7 24.34 -0.09 0.112 0.124 0.124 0.142	11163		=			•	0.0129	0.0551	1929.05		50.01	-1.86	0.168	0.641	1927.66
4.9 17 44 44.076 -6.616 0.6559 1926.36 -30 67.06 -0.13 0.1942 0.0543 1926.36 -26 7 24.34 -0.09 0.112 0.0543 1926.34 -26 7 24.34 -0.09 0.112 0.0552 1926.34 -26 7 24.34 -0.09 0.112 0.0652 1926.34 -26 1 5.10 0.132	11164	•	11	3. 34.0		~		9.0476	1919.02	-28 24	29.45	3;	0.112	0.570	1916.22
6.5 17 34 96,206 0.049 0.0110 0.0657 1926,50 -26 7 24,34 -0.09 0.1102 0.0658 1926,50 -27 4 56,82 2,32 0.1192 0.0639 7.1 17 35 2.07 0.083 0.0846 0.0846 1919,56 -26 1 5.10 0.13 0.162 0.062 6.7 17 35 2.07 0.083 0.0846 0.0846 1919,53 -26 2 5.01 0.13 0.060 7.5 17 35 3247 0.086 0.0846 0.0846 1921,53 -26 2 5.36 1.36 0.13 0.060 6.6 17 36 2.045 0.0846 0.0866 1921,53 -27 4 52,36 1.36 0.123 0.084 6.6 17 36 0.074 0.0864 1921,33 -27 4 52,36 1.36 0.123 0.075 7.5 17 36 0.04 0.0473 1921,37 -27 4 52,36 -3.06 0.123 0.042	11105	•.				77.	0.0110	0.0699	1926.56	•	97.86	-0.11	0.142	0.837	1926.03
9,1 17 34 86,884 0.081 0.0852 1926,08 -29 % 56,82 2,32 0.142 0.642 7,1 17 35 2.076 0.083 0.0846 1919,36 -20 % 1 5.10 0.15 0.124 0.662 8,7 17 35 35.207 0.082 0.0846 1919,33 -20 % 2.3 2.30 0.113 0.503 7,5 17 36 2.036 0.084 0.084 0.0848 1931,31 -20 % 2.36 1.96 0.123 0.703 0.6 17 36 2.036 0.074 0.0843 1931,31 -20 % 2.36 1.96 0.123 0.084 0.0 17 36 2.036 0.012 0.0643 1931,31 -20 % 2.36 1.36 0.124 0.084 0.0 17 36 2.036 0.012 0.0643 1931,31 -20 % 2.36 0.36 0.124 0.084 0.084 0.084 0.084 0.084 0.084 0.084 0.084 0.084 0.084 0.084 0.084 0.084 0.084 0.084 0.084	11167	•	1			:	110	1.0457	1926.54	~	24.34	-0.03	0.142	0.834	1926.02
7.1 17 35 2.07 0.0643 0.0446 199.56 -26 1 5.10 0.15 0.124 0.602 6.7 17 35 35.207 -0.87 0.0446 1927.96 -30 0.124 0.116 0.563 7.5 17 35 31.242 -0.486 0.0694 0.0564 1919.33 -26 23 2.35 -3.06 0.123 0.564 6.6 17 36 2.045 0.0564 1923.37 -27 44 52.36 1.96 0.123 0.703 6.6 17 36 2.045 0.0127 0.0663 1931.31 -20 44 52.36 1.96 0.123 0.764 7.5 17 36 2.040 0.0127 0.0643 1921.47 -29 50 57.90 0.36 0.124 0.075	11160	٧.1				4.	0.0110	0.0652	1926.40	*	56.42	2.32	0.142	0.429	1925.95
8.7 17 35 51.242 -0.392 0.0064 0.0446 1927.96 -30 to 12.41 -2.01 0.110 0.563 7.5 17 35 51.242 -0.486 0.0054 0.0464 1919.93 -28 23 2.35 -5.00 0.123 0.561 0.6 17 36 2.045 0.0594 0.0663 1931.31 -30 47 32.73 -3.04 0.124 0.084 7.5 17 36 9.074 0.0663 1931.31 -30 47 32.73 -3.04 0.124 0.084 0.0 17 36 9.074 0.0673 1931.27 -29 50 13.79 -3.04 0.124 0.084 0.0 17 36 0.047 1921.49 -29 50 13.79 -3.04 0.124 0.075 1932.36 -30 51 52.50 0.126 0.075 1932.36 -30 51 52.50 0.056 0.075 1932.36 -30 51 52.56 0.015 0.075 1932.36 -30 51 52.56 0.056 0.075 1932.36 -30 51 53 -15.65 0.015 0.075 1932.36 -30 57 55 -15.65 0.056 </td <td>11170</td> <td>7.1</td> <td>11</td> <td></td> <td></td> <td></td> <td></td> <td>.0486</td> <td>1919.56</td> <td>-26 1</td> <td>5.10</td> <td>0.15</td> <td>0.124</td> <td>0.602</td> <td>1919.00</td>	11170	7.1	11					.0486	1919.56	-26 1	5.10	0.15	0.124	0.602	1919.00
7.5 17 45 51.4% -0.400 0.0054 0.0054 1919.23 -26 23 2.55 -5.00 0.123 0.561 0.6 17 36 2.045 0.151 0.0054 0.0563 1923.57 -27 44 52.30 1.96 0.123 0.703 0.0 17 36 10.074 0.0127 0.0663 1931.31 -20 47 32.73 -3.04 0.124 0.014 0.0 17 36 10.074 0.0074 0.0673 0.051 1921.49 -29 50 13.99 -3.04 0.124 0.564 0.124 0.0124 0	11174		2			392			1927.96	•	12,41	-2.01	U.110	0.583	1926.36
6.6 17 36 2.045 0.181 0.0094 0.0564 1923.57 -27 44 52.36 1.96 0.153 0.703 0.6 17 36 9.074 0.0663 1931.31 -30 47 32.73 -3.04 0.164 0.064 7.5 17 36 9.040 0.0127 0.06473 1919.27 -29 30 13.99 -3.06 0.123 0.165 0.165 0.0 17 36 19.775 0.094 0.0126 0.0764 1932.36 -30 31 56.36 -1.02 0.126 0.0750 1932.36 -30 15 26.36 -0.36 0.1165 0.964 9.0 17 36 40.876 0.0126 0.0750 1932.36 -30 15 26.36 -0.36 0.1165 0.964 9.1 17 36 40.628 0.0126 0.0750 1932.36 -30 37 5.34 -15.65 0.1165 0.968	11176	7.5	11		•	•			1919.23	-20 23	2.55	-5.00	0.123	0.561	1916.15
6.6 17 36 9.07 0.0127 0.0663 1931.31 -30 47 32.73 -3.04 0.164 0.0644 7.5 17 36 9.070 0.0673 0.0673 1919.27 -29 30 13.99 -3.04 0.123 0.567 8.0 17 36 10.773 0.0699 0.0501 1921.49 -29 35 57.90 0.56 0.124 0.577 9.0 17 36 10.079 0.0750 1932.36 -30 31 36.53 -1.02 0.115 0.963 9.0 17 36 0.0124 0.0750 1932.36 -30 15 26.56 -0.34 0.115 0.0750 1932.36 -30 37 35 -15.65 0.115 0.0750 1932.36 -30 37 5.34 -15.65 0.115 0.0754 1932.36 -30 37 5.34 -15.65 0.115 0.0750 1932.36 -30 37 5.34 -15.65 0.1155 0.0750 1932.36 -30 37 5.34 -15.65 0.1155 0.0750 0.0750 1932.36 -30 37 5.34 -15.65 0.1155 0.0750 0.0750 1932.36 -30 37 5.34 -15.65 0.1156 0.0750	11176	••	11		-	181	.0034		1923.57	-27 44	52.36	1.96	0.125	0.703	1943.02
7.5 17 36 14.775 0.044 0.0011 0.0074 0.0473 1919.27 .29 30 13.99 .3.40 0.123 0.167 8.0 17 36 14.775 0.044 0.0029 0.0501 1921.49 .29 30 37.90 0.56 0.126 0.577 8.9 17 36 22.922 0.059 0.0126 0.0764 1932.34 .30 31 36.53 -1.02 0.165 0.903 9.0 17 36 44.476 -0.040 0.0028 0.0750 1932.96 .30 15 26.50 -0.54 0.115 0.964 9.1 17 36 46.628 -0.296 0.0128 0.0764 1952.36 -30 37 5.54 -15.65 0.125 0.903	11179	•.	11			.433	0.0127	0.0663	1931.31	-30 47	32.73	-3.64	0.164		1950.61
6.0 17 56 14.775 0.0% 0.0099 0.0501 1921.49 -29 56 57.90 0.56 0.126 0.577 6.9 17 36 22.922 0.059 0.0128 0.0754 1932.34 -30 51 56.55 -1.02 0.165 0.983 9.0 17 36 44.476 -0.0% 0.0084 0.0750 1932.96 -30 15 26.56 -0.54 0.115 0.964 9.1 17 36 46.628 -0.296 0.0128 0.0764 1952.36 -30 37 5.54 -15.65 0.185 0.983	11100	7.5	11		_	110.	0.0094	0.0473	1919.27	-29 58	13.99	-3.48	0.123	0.567	1916.22
8.9 17 36 25,922 0.059 0.0128 0.0764 1932,3A -30 51 56,53 -1.02 0.165 0.983 9.0 17 36 44.476 -0.040 0.0088 0.0750 1932,96 -30 15 26,50 -0.54 0.115 0.964 9.1 17 36 46.828 -0.296 0.0128 0.0764 1952,36 -30 37 5,54 -15,65 0.185 0.983	11162	•	11	3		**	0.0099	0.0501	1921.49	-29 55	97.90	95.0	0.126	0.577	11,6161
9.0 17 36 44.476 -0.040 0.0088 0.0750 1932,96 -30 15 26.58 -0.54 0.115 0.964 9.1 17 36 46.628 -0.296 0.0128 0.0764 1932,38 -30 37 5.54 -15.65 0.185 0.983	11165	••	11			640.	0.0126	0.0764	1932.3A	.30 51	56.53	-1.02	0.165	0.983	1951.79
9,1 17 36 %6.028 -0,2%6 0,0128 0.4764 1952,38 -30 37 5,54 -15,65 0.105 0.983	11186	9.0	11			0.0	0.0084	0.0750	1932,96	-30 15	26.58	-0.54	0.115	1,96.0	1932.66
	11109	9.1		36 46.6		.2%	0,0126	9910.0	1952.36	-30 37	5.54	15,65	6.1.0	0.983	1991.79

TABLE III. (continued)

ε	(2)	(3)	(•)	(5)	(9)	(1)	(8)	(6)	(10)	(111)	(12)
11190	6.5	17 57 3.006	0.051	0.0083	9440.0	1927.97	-30 11 40.77	-1.50	0.110	0.581	1926.35
11111	7.3	17 57 15,589	0.011	9600.0	0.0444	1919.64	-28 53 50,30	1.22	0.124	0.605	1919.08
11192	.0	17 37 21.144	0.039	0.0067	0.0589	1931.50	-30 15 25,55	66.0-	U.113	0.756	1951.16
11195	7.0	17 57 31.673	-0.063	0.0036	0.0261	1965.0A	-30 25 3.27	-1.50	0.065	0.320	17.1461
11194	9.5	17 57 37.054	-0,157	0.0088	0.0759	1933.00	-30 7 8.05	1.29	0.115	976.0	1952.71
11175	7.8	17 57 34.014	0,055	0.0036	0.0202	1963.32	-27 52 3.09	-0.97	0.062	0.257	1957,27
11196	6.9	17 57 36.866	0.075	0.0110	0.0641	1926.29	-28 0 17.76	2.12	0.142	0.815	1725.77
111197	6.5	17 57 41,283	0.094	0.0035	0.0225	1962.43	-29 34 28,36	0.37	0.062	0.309	1957.94
11198	.	17 37 44,280	-0.139	0,0093	0.0541	1922.61	-27 22 13.49	0.26	0.123	0.647	1921.71
11200	9.0	17 57 51.441	0.123	0.0103	0.0524	1922.25	-28 2 51.86	-0.76	0.137	0.674	1722,36
11201	8.8	17 37 59.600	-0.169	0,0105	0.0673	1927.42	-30 46 42,52	-4.68	0.141	0.888	1927,62
11202	9.0	17 37 59,252	0.027	0.0067	0.0545	1931.07	-50 3 10.60	2.08	0.113	0.695	1950.61
11208	6.9	17 36 29,571	0,103	0.0110	0.0652	1926,46	-29 59 19,96	-2.41	0.142	0.429	1925.94
11210	9	17 58 45,229	-0,235	0,0036	0.0255	1963,32	-31 19 35,28	-3.78	0.064	0.361	1959,66
11215	8.1	17 30 50.706	0.050	0,0103	0.0539	1925.11	-30 28 7.09	1.26	0.137	0,660	1924,59
11214	0.0	17 39 15,732	0.121	0.0093	0.0546	1922.67	-29 24 55,09	-0.93	0.123	0.653	1921.79
11216	6.7	17 39 25,301	0.025	0.0123	0.0523	1927.74	-30 41 39.03	9.0	0,158	0.632	1926,11
11217	*. 0	17 59 25,541	6 50*0*	0.0095	0.0701	1925.14	-28 17 23,70	0.37	0.127	0.819	1724.71
11222	9.6	17 39 41,090	0.039	%600°0	0.0621	1924.00	-27 49 15.60	11.90	0,126	0.798	1924.01
11224	9.0	17 59 54.665	-0.007	0.0104	0.0597	1923.47	-29 54 44,25	-0.90	0.139	0.847	1925.02
11225	9.9	17 39 57,468	-0.111	0.0103	0.0532	1922,43	-29 54 56.89	0.26	0.137	999.0	1923.17
11228	6.7	17 40 8.727	140.0	%600°0	99%0.0	1919.04	-27 51 42,32	0.22	0.123	0.559	1917,99
11229	9,	17 40 12,714	-0.075	0.0035	0.0166	1961.09	-27 13 10.68	-0.13	0.061	0.265	1956,20
11250	7.8	17 40 17,640	0.047	0.0079	0.0396	1925.20	-30 9 17.15	-0.43	0.103	0.481	1924.43
11239	7.1	17 40 47,669	0,125	0.0103	0.0529	1922,37	-29 49 4,32	-1.65	0.137	0.680	1923.08
11242	4.1	17 41 5,809	0,068	0.0110	0.0598	1925.74	-27 26 11.99	30.0	0.141	0.710	16.4261
11245	9.1	17 41 20,263	0.178	0.0128	0.0750	1932.23	-30 32 57,25	1.98	0.165	996.0	1931.65

TABLE III. (continued)

ε	(2)		(£)	3	(9)	(9)	63	(8)	66	(10)	ε	(112)
11246		17 41	27.620	0.0%	0.0108	0.0560	1924.57	-28 9 25.89	3.65	u.138	0.662	1923.01
11248	*.	17 41	31.132	0.010	0.0108	0.0555	1924.45	-27 12 30,78	1.36	0.138	u.658	1922.91
11251		17 41	54.413	-0.076	0.0054	0.0194	1962.20	-30 9 47,46	0.28	0.059	0.277	1856.34
11252	¥.5	17 41	56,677	004.0-	0.0049	0.0767	1935,04	-30 19 37,68	2.72	0.115	386.0	1932.74
11254		17 41	58.786	-0.066	0.0094	90900	1924.08	-27 26 24,57	2.53	0.126	0.004	1924.09
11255	2	17 42	1.966	0.045	0.0110	0.0450	1926.43	-2A 16 19.92	2,39	0.142	0.627	1925.91
11257	8.5	11 42	4.850	-0,130	0.0095	0.0710	1925,23	-29 49 50.67	-1.42	0,127	0.827	1944,60
11261	9.8	17 42	12,272	-0.098	0.0110	0.0659	1926,56	-28 28 34.59	-3.65	0.142	0.837	1926.03
11262	6.5	17 42	14.243	0.022	0.0112	0.0729	1927.85	-28 1 30,77	2.46	0.144	0,431	1726.61
11263		17 42	42 19,621	-0,128	0.0125	0.0602	1929.47	-30 57 43,54	-3.67	0.161	0.176	1926.64
11270	0.1	17 42	27,523	-0.036	0.0093	0.0580	1923,15	-26 23 14,02	-2.70	U.124	0.731	1922.62
112/2	6.5	17 42	42,467	0,000	0.0110	0.0599	1925.74	-27 11 50.37	1.75	0.141	0,711	1924.52
11273	10	17 42	44.553	9,000-	0.0036	0.4245	1965.42	-26 59 32,90	-1.13	6.064	0.384	1961,75
11276	9.3	17 43	0.789	+C0.0-	0.0105	0.4682	1927.52	-30 27 9.01	-1.54	0.141	006.0	1927,92
11278	0.	17 43	25,626	-0.041	0.0036	0.0256	1963.81	-29 56 51.14	0.10	490.0	0.342	1959,80
11279		17 43	22,555	900.0-	0,0103	0.0524	1922.24	-27 25 12.67	1.30	0.137	0.674	1922.95
11201	0.	17 43	28,661	-0.003	0.0100	0.0558	1924.57	-29 22 27.96	-0.23	0.158	0.658	1922,99
11263	6.7	17 43	43 29,655	0,127	0.0109	0.0655	1925.90	-28 10 6.47	1.11	U.140	0.618	1925.07
11284	6.3	17 43	34,302	-0.09	9600.0	9490.0	1924,22	-29 26 6.24	0.71	0.126	0.770	1923,77
11287	9.0	17 43	55,971	0.011	0.0111	0.0730	1927.19	-28 7 54,39	-0.68	0.143	0.936	1926.75
11266	9.3	17 **	0.927	0,103	0.0111	0.0413	1927.61	-28 43 12,26	-0.05	0.143	0.993	1926.96
11289	9.0	17 **	1,357	0.036	0.0111	0.0813	1927.61	-28 41 45.14	2.03	0.143	0,493	1926.98
11290	9.0	17 44	11.953	00.0-	0.0109	0.4655	1925,91	-29 37 17.86	0.5A	0.1.0	0.616	1925.00
11291	6.0	17 44	22,205	-0.047	0.0036	0.0229	1962.88	-31 10 21.76	-0.55	U.063	6,319	19.6461
11292	Var.	17 44	24.685	0.039	0.0094	0.0465	1919,05	-27 48 46,73	0.61	0.123	0.558	1916.02
11294	6.7	17 44	50.941	0,262	0.0110	0.0651	1926.50	-28 26 54,64	4.36	0.141	6.743	1724.90
11295	9.3	17 44	42.297	-0.016	0.0124	0.0553	1928.50	-30 52 52,35	92.0	0.160	0.707	1927.77

ε	(2)	(3)	(4)	(9)	(9)	(7)	(8)	(6)	(10)	(11)	(12)
11276	٧.1	17 44 41.207	-0.200	0.0111	0.0835	1927.95	-28 23 30,70	-1.05	0.143	1.013	1947.12
11500	6.9	17 44 55.777	0.041	0.0087	9,50.0	1931.09	-30 11 49.06	-1.06	0.113	0.696	1950.69
11304	4.7	17 45 1.883	0.016	0.0110	0.0607	1925.89	-28 44 47.72	1.50	0.141	0.719	1924.66
11306	7.9	17 45 13.699	-0.314	0.0087	0.0517	1930.73	-30 17 0.25	-0.78	0.113	0.620	1929.64
11309	5.5	1/ 45 24.586	0,318	0.0127	0.0668	1931.38	-30 27 36.19	3.80	0.164	0.651	1950.68
11310	9.0	17 45 25.376	-0.025	0.0128	0.0768	1932.43	-30 29 55,29	2.41	0.165	0.949	1991.64
11314	9.7	17 45 32,264	0.042	0.0110	0.0652	1926.45	-28 39 20.80	1.24	0.142	U.A26	1925.93
11315	¥.0	17 45 42,453	-0.122	0.0036	0.0291	1965,29	-30 28 45,36	-0.04	0.065	0.384	1962.11
11316	6.5	1/ 45 41,531	0.047	0.0036	0.0219	1963,53	-28 15 50.13	19.0	0.063	0.316	1959,67
11324	6.0	1/ 46 3,756	0,559	0.0103	0.0425	1919.30	-30 34 55,30	-3.74	0.134	0.518	1918.06
11327	4.7	17 46 11.227	0.026	0.0108	0.0555	1924.45	-27 27 35.70	1.19	0.136	0.657	1922,90
11326	6,1	17 46 14,613	0,174	0.00.0	0.0550	1921.58	-29 25 24,30	-1.87	U.123	0.756	1922,67
11329	7.9	17 46 16,999	0,232	0.0110	0.0650	1926.44	-29 17 58,78	95	0.142	0.827	1925,92
11351	9.2	17 46 25,107	-0,109	0.0088	0.0763	1933,02	-30 19 5,62	1,22	0.115	0.980	1952,72
11354	6.	17 46 29,582	-0.244	0.0094	0.0583	1923,59	-27 22 59,37	-2.39	0.125	0.701	1923,03
11356	6.5	17 46 36,090	0.116	0.0114	1840.0	1923.72	-30 32 5,65	1.34	0.154	0.663	1925,53
11343	7.9	17 46 55.183	-0.025	0,0123	0.0521	1927.65	-30 56 46,61	0.20	U.158	0.630	1926,02
11345	9.0	17 46 51.500	0.011	0.0110	0.0450	1926.44	-28 b 56,26	0.21	0,142	0.826	1925,72
11347	9.0	17 47 8.797	0.038	0.0111	0.0716	1927.04	-27 2 59,93	-1.30	0.143	0.916	1526.60
11346	9.8	17 47 13,679	-0.094	0.0066	0.0768	1933.04	-30 11 4,53	0.29	0.115	0.986	1932,75
11350	7.0	17 47 15.559	-0.051	0.0100	0.0516	1921.78	-27 2 50.43	-2.63	0.127	0.611	1919.65
11352	6.1	17 47 29.966	-0.158	0.0094	0.0628	1924.06	-29 15 54.67	-0.64	0.126	0.407	1924.10
11353	0.0	17 47 36.679	0.017	0.0123	0.0519	1927,60	-30 56 30,87	-2.18	0.158	0,626	1925.98
11356	9	17 47 51,103	0.072	0.0123	0.0520	1927.62	-30 57 26.69	0.29	0.156	0.629	1926.00
11357	6.5	17 47 55,518	0.033	0.0094	0.0629	1924.09	-28 38 46,20	-5.41	0.126	0.A07	1524,11
11360	7.5	17 47 59,421	0.252	0.0000	9640.0	1919.16	-30 42 39,39	-0.28	0.121	0.545	1918.74
11361	6.5	17 47 59,190	-0.411	0.000	0.0552	1921,56	-27 22 55,57	.9.73	0.125	0.716	1542.40

TABLE III. (continued)

11346 6.5 17 46 21.025 0.000 0.0231 1921.47 -77 49 0.70 -1.01 0.123 0.706 1920.41 11346 17.1 17 46 21.025 0.000 0.0036 0.0321 1920.41 11346 0.5 17 46 21.025 0.000 0.0036 0.0321 1920.41 11346 0.5 17 46 21.025 0.000 0.0036 0.0351 1922.46 -30 15.0 15.0 1.10 0.105 0.706 1920.41 11346 0.5 17 46 42.656 0.170 0.1013 0.0029 1922.46 -30 15.0 1.0 1.10 0.105 0.706 1920.41 11346 0.5 17 46 42.656 0.170 0.1013 0.0029 1922.46 -30 15.0 1.10 0.1013 0.7013 1922.41 11349 0.0 1 17 46 42.456 0.0 17 0.0 10.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.	ε	(2)	(3)	€	(9)	(9)	(7)	(8)	(6)	(00)	ε	(31)
6.6.5 17.7 17.4 23.1247 -0.044 0.0237 1958.74 -3.12 1.0 0.0465 0.0346 0.0354 1922.44 -3.12 1.10 0.0465 0.0346 0.0354 1922.48 -3.12 1.10 0.0165 0.0346 1922.48 -3.12 1.10 0.0165 0.0346 1922.48 -3.0 2.3 1.10 0.016 0.017 0.0180 0.0667 1922.48 -3.0 0.216 0.017 0.0180 0.0667 1922.48 -3.0 0.216 0.018 0.0180 0.0467 1932.78 -3.0 0.216 0.018 0.0467 1932.78 -3.0 2.3 1.10 0.116 0.018 0.0467 1932.78 -3.0 2.2 0.116 0.018 0.0467 1932.78 -3.0 2.2 0.116 0.018 0.0467 1932.78 -3.0 2.2 0.116 0.018 0.0468 0.0468 0.0468 0.0468 0.0468 0.0469 0.0469 0.0469 0.0469 0.0469	11362	:	17 46		0.00.0	0.0543	1921.47	ş	-1.07	0.123	0.746	1522.76
6.0.5 17 to 21.025 0.047 0.0479 0.0959 1929.64 -30 16 29.39 1.70 0.106 0.0564 1929.64 -30 16 29.39 1.70 0.106 0.0564 1929.04 -30 16 29.39 1.70 0.106 0.015 0.015 0.015 0.015 0.015 0.015 0.015 0.016	11364	7.7	•	-	0.0036	0.0237	1963.74		1.00	U.065	0.342	1960.67
6.6.6 17. No. 42.656 0.170 0.0103 0.0529, No. 120 1.20, No. 120 0.0104 0.0125 0.0125 0.0220 <th>11365</th> <th>•</th> <th>9</th> <th></th> <th>0.0079</th> <th>0.05A9</th> <th>1929.64</th> <th></th> <th>1.78</th> <th>0.105</th> <th>0.768</th> <th>1525.87</th>	11365	•	9		0.0079	0.05A9	1929.64		1.78	0.105	0.768	1525.87
9.1 17 48 46.537 0.0125 0.0601 1929.42 .36 2.73 1.06 0.115 0.015 0.0125 0.0203 0.	11360		2		0,0103	0.0554	1922.64		2.48	U.138	0.766	1924,25
9.1 17 48 96.229 0.01243 0.01040 0.924.92 -26.36 -29.37 1.17 48 96.213 0.0124 0.01240 0.02647 1926.36 -29 37 1.17 48 0.112 0.0120 0.02647 1926.36 -29 37 2.84 0.112 0.012 0.02667 1926.35 -26 22.85 1.90 0.114 0.012 0.0266 0.0266 17 926.26 2.95 1.90 0.114 0.016 0.0266 0.0266 1.292.26 2.95 2.95 1.79 0.114 0.016 0.0266 1.926.24 -29 2.26.26 2.95 0.114 0.016 0.0266 1.926.24 -29 2.26.26 2.96 0.014 0.014 0.0266 1.926.24 -29 2.26 0.014 0.014 0.0266 1.292.26 -29 2.27 0.014 0.0266 0.0266 1.292.26 -29 2.91 0.014 0.0266 0.0266 1.292.26 -29 2.91	11369	•	9		0.0125	0.0601	1929.44		1.06	0.161	0.774	1928.81
4.1 17 46 59,486 0.041 0.4659 1926,56 -29 37 14,01 -3.53 0.142 0.4657 4.2 17 46 59,186 0.015 0.0066 0.0667 1932,58 -30 6.4,37 2.94 0.115 0.149 6.9 17 79 0.025 0.0160 0.0650 1262,50 -30 2.2,59 1.90 0.113 0.016 6.0 17 79 0.027 0.0167 0.0537 1930,73 -30 2.2,29 2.9 1.13 0.113 0.0657 6.0 17 79 15,492 0.017 0.0107 0.0537 1930,73 -30 2.2,29 2.2,02 0.049 0.0126 1926,48 -27 4 94,37 -0,39 0.113 0.056 1926,48 -27 4 94,37 -0,39 0.113 0.056 1926,48 -27 4 94,37 -0,39 0.113 0.056 1926,48 -27 4 94,37 -0,39 0.113 0.056 0.056 1926,48 -27 4 94,37 -0,39	11370	9.1	2		0.0125	0.0600	1929,42		1.17	6,161	0.773	1928.80
4.2 17 48 59,186 0,015 0,0066 0,0667 1932,54 30 6 24,37 2,44 0,115 0,0146 0,0468 1925,03 26 22,55 1.90 0,144 0,173 4,0 17 7 0,0146 0,0317 1930,73 -26 22,59 2.91 0,113 0,520 6,5 17 7 0,0407 0,0317 1930,73 -29 32,29 2.02 0,044 0,341 6,6 17 7 0,0407 0,0317 1930,73 -29 32,29 2.02 0,044 0,341 6,6 17 7 0,0407 0,0317 0,0317 0,045 1932,23 -29 32,30 -0,193 0,144 9,0 17 7 0,0407 0,050 0,050 0,050 0,045 0,045 0,045 0,045 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046 0,046	11375	۲.	9		0.4110	0.4659	1926,56		-3.23	0.142	6.837	1926.03
6, 17 49 0.122 0.0106 0.586 1925.03 126 26.03 1.90 0.113 0.113 0.580 6, 0 17 49 0.132 0.117 0.0003 0.0255 1964.24 -29 32 25.96 2.91 0.113 0.620 6, 1 17 49 15.432 0.010 0.0036 0.4255 1964.24 -29 32 25.99 -2.02 0.013 0.620 6, 1 17 49 15.432 0.010 0.0036 0.0256 1364.24 -29 32 25.99 -2.02 0.013 0.0256 0.0256 137.34 -30 4 25.71 1.53 0.113 0.620 9, 1 17 49 27.246 0.012 0.0156 0.0562 1352.23 -30 4 24.01 0.185 0.185 9, 0 17 50 0.012 0.0156 0.0562 1352.23 -2.02 0.056 0.185 9, 0 17 50 0.025 0.0250 1352.23 -2.02 0.025 0.0250 1, 0 0.025 0.003 0.004	11376	4.2	2		0.0088	0.0667	1932,54	•	2.84	0,115	0.847	1952,18
6.5 17 0.0004 0.0534 0.0255 1964.24 -29 22.05 2.05 0.004 0.036 0.0255 1964.24 -29 32.55 2.02 0.0404 0.034 0.0253 1964.24 -29 32.05 2.02 0.0404 0.0517 1930.73 -50 4 49.37 -0.39 0.113 0.0527 1930.73 -50 4 49.37 -0.39 0.113 0.0528 1926.46 -29 32.53 -2.02 0.0404 0.0558 1926.46 -27 4 52.71 1.53 0.113 0.0569 1926.46 -27 4 52.71 1.53 0.113 0.0576 1932.23 -20 4 49.37 0.113 0.114 0.0569 1926.73 -27 4 52.71 1.53 0.115 0.0569 1926.73 -27 4 49.37 0.116 0.116 0.0569 1926.73 -27 4 49.37 0.116 0.116 0.0569 1926.73 -27 4 49.37 0.116 0.116 0.0569 1932.23 -20	11379	•	•		0.0100	0.0588	1925,03	-28 26 22.55	1.90	0.140	0.733	1924.12
6.5 17 99 15,352 -0.006 0.0256 0.0256 1964,24 -29 32,359 -2.02 0.004 0.0134 0.0254 1956,73 -30 4 49,37 -0.39 0.113 0.620 6.6 17 49 24,17 0.010 0.0556 1926,46 -27 4 52,71 1,53 0.1142 0.774 9.1 17 49 27,346 -0.239 0.0126 0.0764 1932,36 -27 4 52,71 1,53 0.1142 0.774 9.0 17 40 27,246 0.0249 1932,36 -27 47 27 44,31 0.165 0.0240 1932,36 -0.03 0.045 0.0240 1932,36 -0.045 0.045 0.0240 1932,37 -28 24,96 0.045 0.0240 1932,37 -28 24,96 0.045 0.046 0.0240 1932,37 -28 24,96 0.046 0.046 0.0240 1932,37 -28 49,68 0.043	11568	9			0.0067	0.0517	1930.73	-30 12 22,98	2.91	0,113	0.620	1929.64
6.6 17 49 32.170 0.010 0.0857 0.055.46 1926.46 -27 4 52.71 1.53 4.142 0.112 6.6 17 49 27.346 0.127 0.0110 0.0658 1926.46 -27 4 52.71 1.53 4.142 0.174 9.1 17 49 35.736 -0.239 0.0128 0.0754 1932.36 -30 41 24.01 0.35 0.0754 0.0750 1932.23 -30 41 24.01 0.155 0.0754 0.0750 0.0754 1932.23 -30 41 24.01 0.155 0.155 0.155 0.155 0.155 0.055 0.065 0.0754 1932.23 -30 41 24.01 0.065 0.0754 1932.23 -20 42 2.25 0.055 <th< th=""><th>11369</th><th>6.5</th><th>•</th><th>_</th><th>0.0036</th><th>0.4255</th><th>1964,24</th><th>32</th><th>-2.02</th><th>0.0</th><th>0.341</th><th>1960.21</th></th<>	11369	6.5	•	_	0.0036	0.4255	1964,24	32	-2.02	0.0	0.341	1960.21
9.6 17 49 27.3u6 0.127 0.0658 1926.4d -27 4 52.71 1.53 0.185 0.774 9.1 17 49 35.346 0.0239 0.0126 0.0764 1932.36 -30 45 22.30 -4.31 0.185 0.185 9.0 17 30 0.722 0.0126 0.0769 1932.35 -30 41 24.01 0.185 0.0126 0.0769 1922.23 -30 41 24.01 0.185 0.0126 0.0240 1922.23 -30 41 24.01 0.185 0.0240	11393		6		0.0087	0.0517	1930.73	•	-0.39	0.113	0.620	1929.04
9.1 17 93.5.346 -0.249 0.0126 0.0764 1932.33 -36 35 22.30 -4.31 0.166 0.966 9.0 17 20 0.722 -0.043 0.0750 1932.23 -30 41 24.01 0.55 0.165 0.966 7.7 17 20 0.172 0.066 0.0056 0.0240 1952.73 -28 24.96 0.0.95 0.0240 0.0647 1990.77 -28 2.965 0.025 0.027 0.02	11394	9.	6		0.0110	0.0656	1926,46	*	1.53	0.142	0.774	1925.32
9.0 17 0.042 0.0128 0.0520 1932.23 -50 41 24.01 0.055 0.0128 0.0652 1925.06 -27 47 6.96 -0.055 0.0052 1925.06 -27 47 6.96 -0.055 0.0054 1925.06 -27 47 6.96 -0.055 0.0054 1925.06 -27 47 6.96 0.0129 0.0240 1995.07 -28 2.9.85 0.099 0.0103 0.0467 1995.07 -28 2.9.85 0.59 0.0127 0.0127 0.0127 0.0128 0.057 120.242 2.8.36 0.137 0.0128 0.0594 1929.28 -28 0.056 0.137 0.0128 0.0594 1929.28 -30 0.35 0.137 0.0128 0.0594 1929.28 -30 0.35 0.136 0.0128 0.0594 1929.28 -30 0.35 0.136 0.0134 0.0594 1929.28 -30 0.35 0.146 0.0146 0.0128 0.0594 0.0594	11395	9.1	•	-	0.0128	0.0764	1932,38	20	.4.31	0,165	0.983	1941,79
7.7 17 5u 0.1179 0.0655 0.0692 1925.06 -27 37 6.96 -0.655 0.1270 0.0640 1925.06 -27 34 6.96 0.0693 0.0240 1943.77 -26 2 49.65 0.999 0.0034 0.0240 1943.77 -27 16 22.22 2.55 0.123 0.013 6.9 17 5u 29.796 -0.042 0.0044 0.0647 1919.07 -27 16 22.22 2.55 0.123 0.513 6.7 17 5u 29.796 -0.004 0.0103 0.0654 1922.36 -20 ab 4.36 0.137 0.0125 0.0594 1929.26 -30 bit 4.36 0.141 0.715 6.6 17 5u 5b.290 0.371 0.0125 0.0594 1929.26 -30 bit 4.36 0.141 0.715 8.7 17 5u 5b.2117 0.0125 0.0594 1929.26 -30 bit 0.36 0.181 0.054 0.054 0.054 0.054 0.054 0.054 0.054 0.054 0.054 0.054	11398	9.0	2	-	0.0128	0.0750	1932,23	7	0.55	0.165	996.0	1951.65
6.5 17 50 11.774 0.066 0.0036 0.0240 1963.77 -26 2 49.65 0.99 0.063 0.317 6.9 6.9 6.063 0.317 6.9 17 50 23.945 0.139 0.0094 0.0467 1919.07 -27 16 22.22 2.55 0.123 0.559 0.559 0.7 17 50 29.946 0.0042 0.0103 0.0556 1922.36 -28 50 43.63 -8.36 0.137 0.679 0.5 17 50 31.397 0.0042 0.0110 0.0607 1925.89 -29 0 8.26 4.36 0.141 0.7 19 0.5 17 50 31.397 0.0371 0.0125 0.0594 1929.28 -30 31.56 0.52 0.161 0.7 15 0.7 17 50 54.17 0.012 0.0125 0.0594 1929.29 -30 35.00 2.68 0.141 0.7 16 0.7 16 0.7 17 51 11.446 0.0 16 0.0 112 0.0 18 1928.39 -29 0 35.00 2.43 0.1 18 1.0 18 0.3	11399	7.7	2		0.0095	0.0692	1925.08	57	-0.65	0.127	0.811	1924.63
6.9 17 50 29.945 0.139 0.0094 0.0467 1919.07 -27 16 22.22 2.55 0.123 0.559 6.7 17 50 29.996 -0.042 0.0103 0.0568 1922.36 -28 50 43.63 -8.36 0.137 0.679 6.8 17 50 31.597 -0.004 0.0110 0.0607 1925.69 -29 0 8.24 4.36 0.141 0.716 6.8 17 50 50.290 0.371 0.0125 0.0594 1929.28 -30 31.50 0.52 0.161 0.766 6.7 17 50 50.217 0.018 0.0125 0.0594 1929.28 -30 31.50 0.52 0.161 0.766 6.7 17 51 11.448 -0.064 0.0112 0.0434 1928.57 -29 30 35.00 2.88 0.145 1.052 6.7 17 51 11.448 -0.064 0.0135 0.0208 1962.37 -29 30 35.00 0.208 0.1083 0.0208 1962.37 -29 30 35.96 -0.20 0.063 0.300 6.2 17 52 2.644 -0.064 0.0035 0.0208 1962.37 -29 30 12.66 -1.25 0.069 0.300 6.4 17 55 24.659 -0.118 0.0035 0.0225 1962.37 -29 30 12.66 -1.25 0.060 0.300 6.7 17 55 4.663 -0.074 0.035 0.0225 1962.37 -29 30 12.66 0.025 0.0208 0.0208 0.0309 0.0225 1962.37 0.000 0.0008 0.0009	11400	6	20		0.0036	0.0240	1963.77	~	0.99	0.063	0.317	1859.57
6.7 17 50 29.946 -0.042 0.0550 1922.36 -28 50 43.63 -6.36 0.137 0.0650 1925.36 -29 0 6.26 4.36 0.141 0.713 8.7 17 50 53.290 0.371 0.0125 0.0594 1929.26 -30 51 31.56 0.52 0.161 0.716 9.2 17 50 50.117 0.0125 0.0594 1929.29 -30 51 6.91 0.96 0.161 0.0594 1929.29 -30 51 0.96 0.161 0.0594 1929.29 -30 51 0.96 0.161 0.065 0.065 0.065 0.065 0.065 0.065 0.065 0.065 0.065 0.066 <th< th=""><th>11403</th><th>6.9</th><th>17 50</th><th></th><th>0.0094</th><th>0.0467</th><th>1919.07</th><th>-27 16 22.22</th><th>2.55</th><th>0.123</th><th>0.559</th><th>1916.00</th></th<>	11403	6.9	17 50		0.0094	0.0467	1919.07	-27 16 22.22	2.55	0.123	0.559	1916.00
6.7 17 50 31.397 -0.004 0.0125 0.04607 1925.69 -29 0 6.26 4,36 0.1431 0.7159 6.8 17 50 50.229 0.371 0.0125 0.0594 1929.26 -30 51 31.56 0.52 0.161 0.765 9.2 17 50 50 11.446 -0.0564 0.0112 0.0634 1929.27 -29 50 35.00 2.86 0.145 1.056 9.2 17 51 13.446 -0.0564 0.0112 0.0413 1923.96 -27 17 6.90 2.43 0.145 1.056 9.2 17 52 2.544 -0.054 0.0208 0.0208 1961.17 -30 35.36 -0.20 0.063 0.0228 1962.37 -29 36 2.75 0.063 0.0228 1962.37 -29 36 2.75 0.063 0.0236 1962.37 -29 36 12.75 0.066	11404	1.0	2	-	0.0103	0.0526	1922,36	96	-8.38	0,137	0.679	1923.07
8.6 17 50 50,290 0.371 0.0125 0.0594 1929,29 -30 51 51,56 0.55 0.161 0.765 8.7 17 50 50,117 0.0125 0.0594 1929,29 -30 51 51,51 0.96 0.161 0.0125 0.0594 1929,29 -30 51 51,51 0.96 0.161 0.068 0.0112 0.0634 1928,57 -29 50 35,00 2.68 0.145 1.052 8.7 17 51 17,52 2.644 -0.064 0.0635 0.0208 1961,17 -30 35,96 -0.20 0.063 0.0225 1962,37 -29 50 12.66 0.063 0.0035 0.0226 1962,37 -29 50 12.66 0.063 0.0035 0.0226 1962,37 -29 50 12.66 0.069 0.0035 0.0226 1962,37 -29 50 12.66 0.069 0.069 0.0035 0.0226 1962,37 -29 50 12.66 0.069 0.069 0.0336 0.0326 0.0326 0.0326 0.0326 0.0326 0.0326 0.0326 0.0326 0.0326 0.0326 0.0326 0.0326	11405		17 50	_	0.0110	0.0607	1925.69	•	4.38	U.141	0.719	1924.66
8.7 17 50 56.117 0.018 0.01825 0.0594 1929.29 -30 51 6.91 0.96 0.161 0.0182 0.0594 1929.29 -29 50 35.00 2.88 0.145 1.052 9.7 17 51 19.495 0.0182 0.0419 1923.96 -27 17 6.90 2.43 0.126 0.796 9.2 17 52 2.544 -0.064 0.0256 1961.17 -30 35.36 -0.20 0.063 0.0226 1962.37 -29 35.36 -0.20 0.063 0.302 8.4 17 52 24.65 -0.20 0.0225 1962.37 -29 36 12.56 -0.20 0.063 0.0326 1962.37 -29 36 12.56 -0.20 0.065 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.0	11409	8.8	20		0.0125	0.0594	1929.28	ន	0.52	0.161	0.765	1928.65
9,2 17 51 11,446 -0.066 0.0112 0.0834 1928,57 -29 50 35.00 2.86 0.145 1.052 8,7 17 51 19,552 0.202 0.0034 0.0619 1923,96 -27 17 6.90 2.43 0.126 0.796 8,7 17 52 2.644 -0.064 0.0035 0.0208 1961,17 -30 35 35,96 -0.20 0.063 0.307 8,4 17 52 24,659 -0.118 0.0035 0.0225 1962,37 -29 56 12.66 -1.25 0.060 0.300 9,0 17 55 4,683 -0.074 0.0037 0.0354 1966,83 -31 10 56.78 -2.7A 0.065 0.427	11411	7.0	20		0.0125	0.0594	1929,29	5	96.0	0.161	991.0	1926.66
6.7 17 51 17 53.96 -27 17 6.90 2.43 0.126 0.796 6.2 17 52 2.644 -0.064 0.0035 0.0208 1961.17 -30 35 35.96 -0.20 0.063 0.0225 1962.37 -29 36 -1.25 0.066 0.300 9.0 17 55 4.643 -0.074 0.0037 0.0374 1966.83 -31 10 56.78 -2.78 0.065 0.427	11413	9.5	15	-	0,0112	0.0834	1924.57	Š	2.68	0.145	1.052	1928.09
8.2 17 52 2.644 -0.064 0.0035 0.0208 1961.17 -30 35 35,96 -0.20 0.063 0.307 8.4 17 52 24.659 -0.118 0.0035 0.0225 1962.37 -29 56 12.66 -1.25 0.060 0.300 9.0 17 55 4.683 -0.074 0.0037 0.0354 1966.83 -31 10 56.78 -2.74 0.065 0.427	11415	6.7	21		0.0094	0.0619	1923.96		2.43	0.126	0.796	1723.78
8,4 17 52 24,459 -0,118 0,0035 0,0225 1962,37 -29 56 12,66 -1,25 0,060 0,300 9,0 17 55 4,483 -0,074 0,0037 0,0324 1966,83 -31 10 56,78 -2,7A 0,065 0,427	11425	9.2	25	-	0.0035	0.0208	1961.17		-0.20	U.063	0.307	1957.56
9.0 17 55 4.663 -0.074 0.0037 0.0374 1966.83 -31 20 56.78 -2.7A 0.065 0.427	11450	*.	25		0.0035	0.0225	1962,37		-1.25	0.060	0.300	1957.40
	11451	9.0	53		0.0037	4660.0	1946.83	-31 10 56,78	-2.78	U.065	0.427	1963.91

Notes to Table III.

- a. From the Cordoba B catalogue
- b. Epoch of place and orientation 1950.0
- c. At epoch of central date.

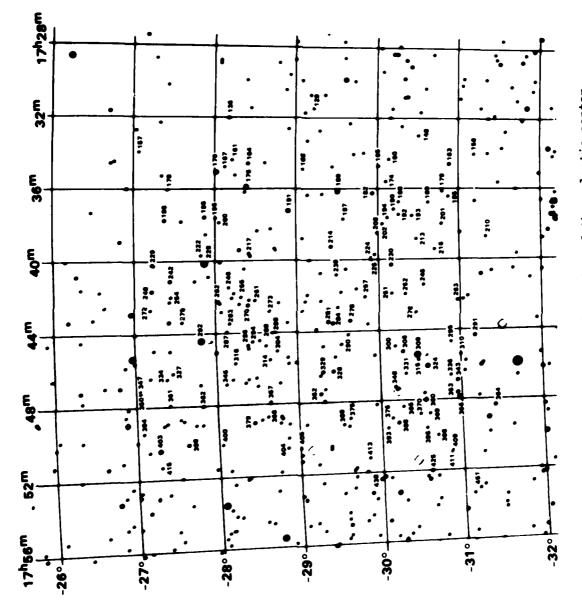


Fig. 1. Finding chart for the direction of the galactic center. Stars are identified by the last three digits of the Cordoba B identification number.

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This paper describes the construction of a catalog of positions and proper motions for 130 stars in the direction of the galactic center. All available information for stars within $\sim 2^{\circ}$ of this point has been utilized to produce the best and densest possible reference system. The reference frame of the catalog is that of the Southern Reference Star (SRS) program. The typical star in this catalog has a position and angular velocity based on 16 observations from six source catalogs whose epochs of observation span 77 years. The root mean square positional uncertainty is 0.49 at 1975.0. A total of 13 source catalogs dating back to 1847 have been used. Additional information included central dates for right accession and declination, position and proper motion variances, identification numbers, and apparent magnitudes.

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